

# Synopsys and Picocom

## In-Chip Monitoring IP Subsystem Embedded in 12nm Baseband SoC for 5G Small Cells

*“ We were looking for a modular and highly accurate PVT monitoring solution—the Synopsys in-chip monitoring IP subsystem delivered on both counts. In addition to our internal engineering requirements, customers are now also benefitting from being able to monitor performance over the lifetime of the product. A 5G small cell may operate for over a decade in potentially hostile environments without forced air cooling. It is important to be able to monitor them remotely once deployed in the field.”*

~Peter Claydon, Picocom President



### Project Overview

Small cells are short-range, low-power wireless transmission systems or base stations designed specifically for smaller geographical areas or indoor/outdoor applications. They have all the main characteristics of conventional base stations but can handle much higher data rates for individual users.

Picocom is a UK-based 5G Open RAN baseband semiconductor and software specialist and is one of the key players in the small cell market. The company designs and markets Open RAN standard-compliant baseband SoCs and carrier-grade software products for 5G small cell infrastructure. Picocom's distributed unit (DU) baseband SoC, called the PC802, is designed to be deployed in cityscapes and buildings to increase 5G coverage and reduce the processing load on 5G macro cells under the Open RAN initiative.

### Challenges

Due to the lifespan of these small cells in the field, it is critically important to gain deep insights into the dynamic conditions within the SoC device itself. This can be achieved by embedding real-time environmental (PVT) monitors that provide actionable insights regarding silicon health throughout the product's lifecycle.

### Synopsys Solution

Process, Voltage and Temperature (PVT) monitoring is critical to achieving successful operation and performance of advanced node and FinFET semiconductor devices such as this 12nm Small Cell SoC. Increasing transistor and power density presents challenges to the in-chip management of dynamically changing physical conditions during manufacture, testing and in-field operation. This provides enhanced visibility of real-time environmental conditions on the chip.

Picocom selected the Synopsys in-chip PVT monitoring IP subsystem, which was distributed across the PC802 5G Small Cell PHY SoC. Distributing monitors across the device provides enhanced visibility of the dynamic environmental conditions on chip, including temperature at hotspots, voltage levels at critical circuits and process variations across the FinFET die, not just die-to-die.

As part of the Synopsys Silicon Lifecycle Management (SLM) family, the in-chip monitoring IP subsystem offers a high-accuracy, highly featured modular solution to SoC designs. The subsystem also features a PVT Controller, which monitors and manages the subsystem of monitors, relieving the system control processor of many tasks associated with monitoring and managing the subsystem.

To achieve silicon success of its 12nm baseband SoC, Picocom also leveraged the Synopsys Multi-Protocol 25G PHY IP, supporting PCIe 4.0, 25G Ethernet, JESD, and CPRI standards for telecom applications. The IP is small in area and provides a low active and standby power solution, allowing Picocom to achieve low-latency, low-power, and high throughput connectivity. The IP is compliant with the PCIe 4.0 standard, giving confidence to Picocom that their SoC will achieve successful interoperability.

## Key Benefits of Embedded In-Chip Monitors for 5G Small Cell SoCs

- Improved accuracy of thermal monitoring with embedded temperature sensors closer to hotspots
- Lifetime thermal stress analysis, supporting increased chip reliability
- Real-time, multi-sense point embedded supply monitoring, supporting supply voltage optimization at critical circuits
- Measurement of process variability at multiple points across the die, allowing global variation assessment
- In-test and in-field production variability analysis of delay chain circuits, providing circuit delay assessment for power/speed optimization
- PVT Controller monitors and manages the subsystem of monitors, relieving the system control processor of many tasks associated with monitoring and managing the subsystem

## PC802 5G Small Cell PHY SoC

- The Picocom PC802 is a purpose-designed PHY SoC for 5G and 4G small cell disaggregated and integrated RAN architectures and includes support for industry-leading Open RAN specifications. It runs on a 25mm x 25mm thermally enhanced FCBGA and has x5 embedded temperature sensors and x5 voltage monitors, each with 16 sense points. Its PVT Controller manages the subsystem of monitors, and PC802's silicon runs 5G and 4G software, with secure on-chip boot capability and debug and device monitoring as standard. PC802 also includes:
- Ceva XC12 5G-optimised 1280-bit vector signal processors
- RISC-V scalar processor clusters
- Codecs: LDPC, Turbo and Polar
- Fourier transforms: FFT, iFFT
- Equalisers: MMSE/MMSE-IRC/MLD
- Digital Front End (DFE)
- O-RAN eCPRI Open Fronthaul

## ORANIC In-line PHY and NIC board for O-DU

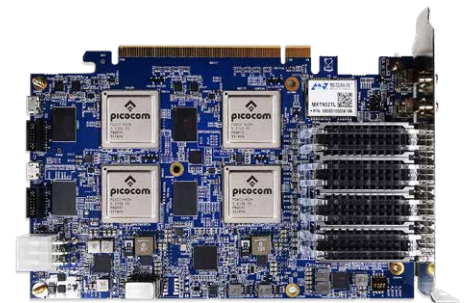
The PC802 'ORANIC' is a Small Cell Forum award-winning Open RAN PHY and NIC board. The board-level product based on the PC802 SoC is designed for 5G/4G O-RAN O-distributed servers (O-DUs). ORANIC is an evaluation platform for Indoor enterprise, neutral host, cloud-native deployments and outdoor small cell applications. ORANIC interfaces to L2 software via the Open RAN SCF FAPI interface. It includes 4 PC802s, driving 4 25G SFP interfaces conformant to the O-RAN Open Fronthaul interface. It is capable of driving 16 2T2R or 8 4T4R O-RUs (radio units).

## Key Features

- 4x PC802 SoC Silicon
- 32-bit LPDDR4 SDRAM
- 4x SFP 10/25G Ethernet for O-RAN OFH
- SCF FAPI interfaces to/from external NPU
- OCXO for holdover feature
- Synchronization (GPS/GNSS and 1588V2) and clocking functions



Picocom PC802 5G Small Cell PHY SoC



ORANIC In-line PHY and NIC board for O-DU